

Remarks/Arguments

Claims 1-19 remain pending. No claims are amended by this response.

The instant patent application relates to methods and apparatuses for detecting faults in the highly complex tools utilized in the fabrication of semiconductor devices. Specifically, in conventional fault detection systems:

all sensors are accorded equal weight in generating the fault detection index. This approach thus does not include potentially valuable correlation between related operational parameters that could provide more reliable fault detection information. (Emphasis added; page 2, lines 16-19)

Therefore, embodiments of fault detection methods of the present invention:

group correlating active sensors together as one technique to improve fault detection. Sensor grouping enables a specialized fault detection index 116 to be calculated based upon tool operational parameters known to correlate with one another. Examples of correlating sets of tool operational parameters may include sets of tool temperatures or sets of tool pressures. Sensor grouping eliminates coincidences in tool data that could represent a fault, when in fact no tool fault has occurred. (Emphasis added; page 7, lines 1-6)

Accordingly, pending independent claims 1 and 15 recite:

1. A fault detection method comprising:
sensing a group of correlating operational parameters of a semiconductor processing tool operating under a recipe;
... forming an input vector including the group of correlating operational parameters and the at least one non-correlating operational parameter;
... selecting from the reference data library one or more nearest neighbor vectors to the input vector based upon a similarity with the group of correlating operational parameters; and
generating a fault detection index from the selected nearest neighbor vectors. (Emphasis added)

15. An apparatus for detecting a fault in a semiconductor processing tool, the apparatus comprising:
... a memory coupled to the controller, the memory storing a computer program in computer readable format including computer instructions to control said controller to,
receive from the first and second sensors correlating operational parameters of the semiconductor processing tool operating under a recipe,
... generate a fault detection index from comparing the sensed correlating operational parameters to the corresponding operational parameters recorded during prior runs. (Emphasis added)

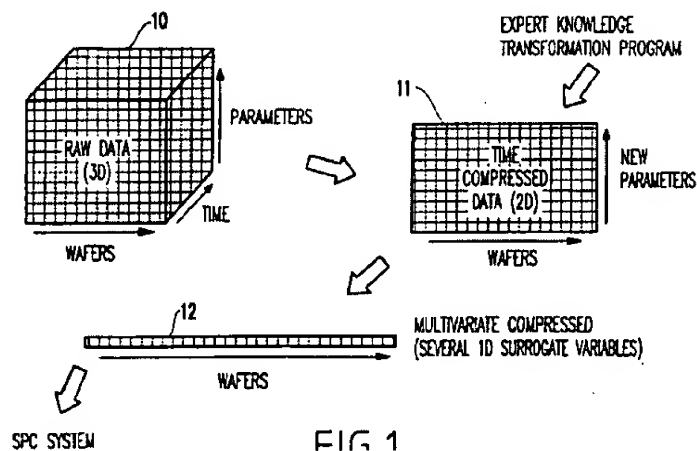
The Examiner has rejected all of the pending claims as anticipated by U.S. patent no. 6,442,445 to Bunsofske et al. ("the Bunsofske patent"). These claim rejections are traversed as follows.

As a threshold matter, the Examiner is reminded that pending claims 1-19 stand rejected as anticipated, and not merely obvious, in light of the Bunsofske patent:

[t]he distinction between rejections based on 35 U.S.C. 102 and those based on 35 U.S.C. 103 should be kept in mind. Under the former, the claim is anticipated by the reference. No question of obviousness is present. In other words, for anticipation under 35 U.S.C. 102, the reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught must be inherently present. (Emphasis added; MPEP 706.02)

Here, the Bunsofske patent fails entirely to teach, or even suggest, a fault detection method which groups together correlating operational parameters.

Figure 1 of the Bunsofske patent (reproduced below), is a simplified schematic view showing the fault detection approach of the Bunsofske patent:



This Figure 1 of the Bunsofske patent indicates that fault detection is achieved by first reducing a three-dimensional matrix (10) of raw data (30) to a two-dimensional matrix of time compressed data (20). Utilizing human expertise (11) in the form of a configurable transformation programming language, the two-dimensional matrix of time-compressed data (20) is then transformed into a one-dimensional set (12) of scalar "intermediate" variables for each wafer processed. (Col. 5, line 47 - col. 6, line 3).

The approach of the Bunsofske patent stands in marked contrast to claimed embodiments of fault detection methods in accordance with the present invention, wherein human expertise is

employed up front to identify those operational parameters known to correlate with one another. In accordance with embodiments of the present invention, input vectors grouping together such correlating parameters are then formed and compared to a model, in order to identify fault events. Nowhere does the Bunsofske patent teach, explicitly or even implicitly, this aspect of grouping together operational parameters known to correlate with one another.

At column 5, line 63 - column 6, line 1, the Bunsofske patent does state that the configurable transformation programming language "selects a set of process variable time series", and "performs vector-to-vector operations (to produce a new set of time series)". However, this selection appears to relate to the time compression step of the Bunsofske patent, and there is no teaching or suggestion in that patent regarding making any selection based upon operational parameters known to correlate with one another.

Finally, the Bunsofske patent recites at column 7, lines 29-35 a formula for calculating a "correlation value", and at column 8, lines 20-31 recites a formula for calculating a "modified Hotelling Statistic" utilizing a "correlation matrix" value. However, the "correlation" values of the Bunsofske patent are not used in remotely the same sense as in the instant application. For example, the "correlation matrix" value of the Bunsofske patent is utilized during the normalization of data, a step not recited by the pending claims.

Based upon at least the failure of the Bunsofske patent to teach, or even suggest, grouping together correlating operational parameters, it is respectfully asserted that pending claims 1-19 of the instant patent application cannot be considered anticipated by that reference. The Examiner's rejection of the claims as anticipated is improper and should be withdrawn.

The Examiner has further rejected claims 6-9, and 13-14 as obvious in light of the Bunsofske patent taken in combination with U.S. patent no. 5,859,964 to Wang et al. ("the Wang patent"). These claim rejections are traversed as follows.

The Examiner is further reminded that in order to establish a prima facie case of obviousness, "the prior art reference (or references when combined) must teach or suggest all the claim limitations." MPEP 2142. Here, the combination of the Bunsofske and Wang patents fails to teach or even suggest, a fault detection method wherein correlating parameters are grouped together.

As just described, the Bunsofske patent does not teach or even suggest a fault detection method wherein correlating operational parameters are grouped together. The Wang patent does nothing to supply such a teaching.

Specifically, while the Wang patent does relate generally to fault detection methods and systems, the specific mechanisms for recognizing and predicting faults is described only with reference to the particular model of tool behavior. (See col. 8, lines 54-63). Nowhere does the Wang patent specifically teach or even suggest relying upon correlation between different operational parameters to detect faults.

Based at least upon the failure of the combined Bunsofske and Wang patents to teach or suggest, grouping together correlating operational parameters for fault detection, it is respectfully asserted that claims 5-9 and 13-14 cannot be considered obvious in light of those references. The Examiner's rejection of the claims as obvious is improper and should be withdrawn.

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested. If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



Kent J. Tobin
Reg. No. 39,496

TOWNSEND and TOWNSEND and CREW LLP
Tel: 650-326-2400
Fax: 650-326-2422
KJT:km:ejt
60213424 v1